## Question 19

Correct

Mark 1.00 out of 1.00

P Flag question In empirical risk minimization the predictor is:

Select one:

- a. None of the above.
- b. A probabilistic function.
- c. A deterministic function.

## Question 20

Correct

Mark 1.00 out

P Flag

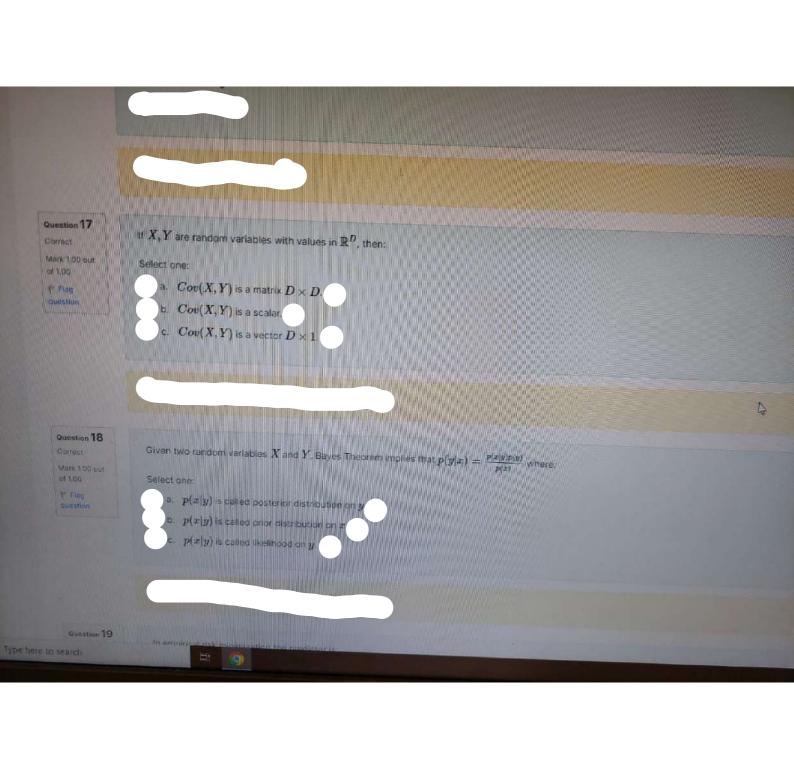
The regression matrix A of the data  $(x_i,y_i), i=1,\ldots,N, x_i,y_i\in\mathbb{R}$ , for a polynomial model of degree k-1, has elements:

Select one:

a. 
$$a_{i,j}=x_i^{j+1}, i=1,\ldots,N, j=1,\ldots,k.$$

$$a_{i,j} = x_i^{j-1}, i = 1, \dots, N, j = 1, \dots, k.$$

c. 
$$a_{i,j}=x_i^j,\,i=1,\ldots,N,\,j=1,\ldots,k$$



## Question 20

Correct

Mark 1.00 out of 1.00

P Flag

question

The regression matrix A of the data  $(x_i,y_i)$ ,  $i=1,\ldots,N$ ,  $x_i,y_i\in\mathbb{R}$ , for a polynomial model of degree k-1, has elem

Select one:

a. 
$$a_{i,j} = x_i^{j+1}, i = 1, \dots, N, j = 1, \dots, k$$
.

b. 
$$a_{i,j} = x_i^{j+1}, i = 1, \ldots, N, j = 1, \ldots, k$$
.

c. 
$$a_{i,j}=x_i^j, i=1,\ldots,N, j=1,\ldots,k$$

## Question 21

Correct

Mark 1.00 out of 1.00

f' Flag

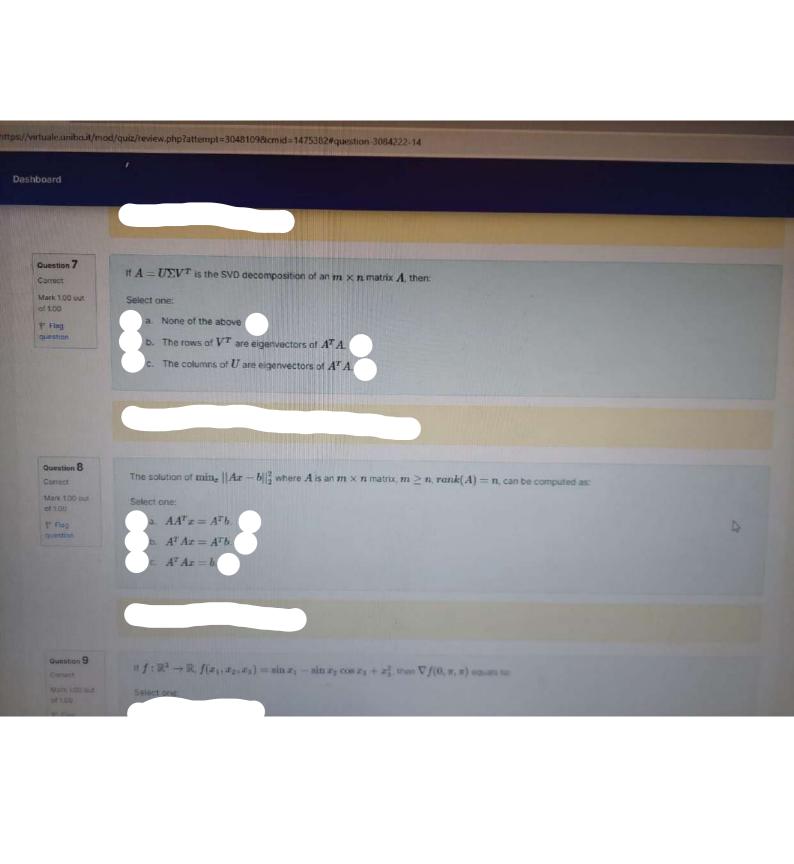
If U is an n imes n orthogonal matrix,  $x \in \mathbb{R}^n$ , then:

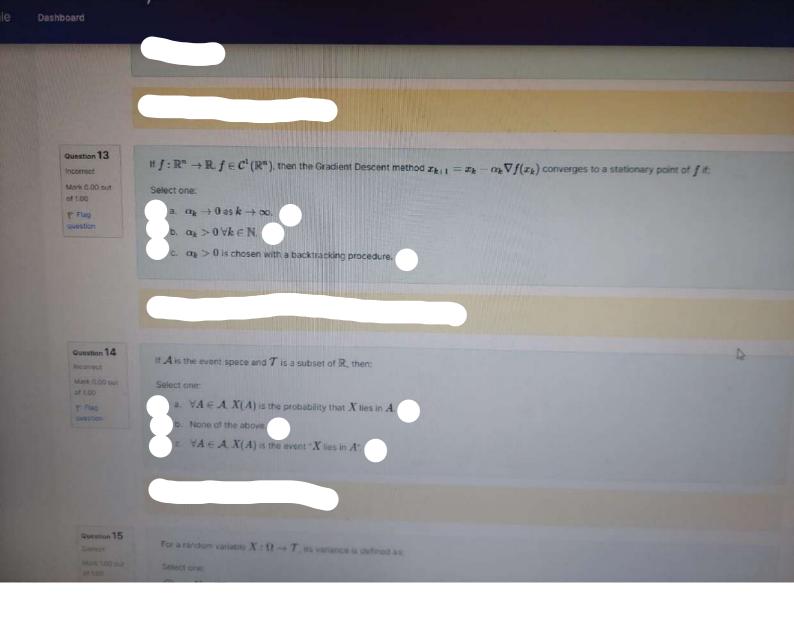
Select one:

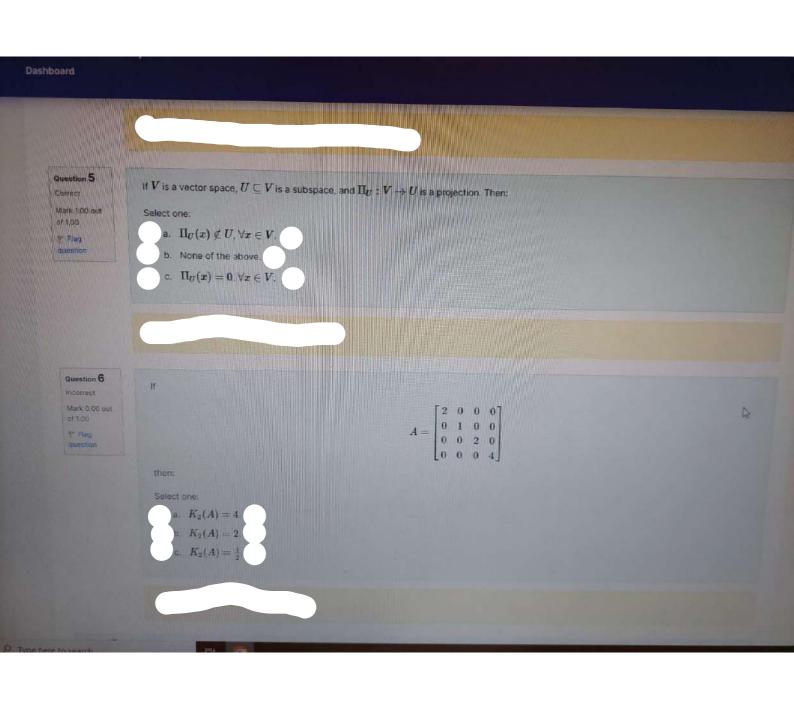
a. None of the above.

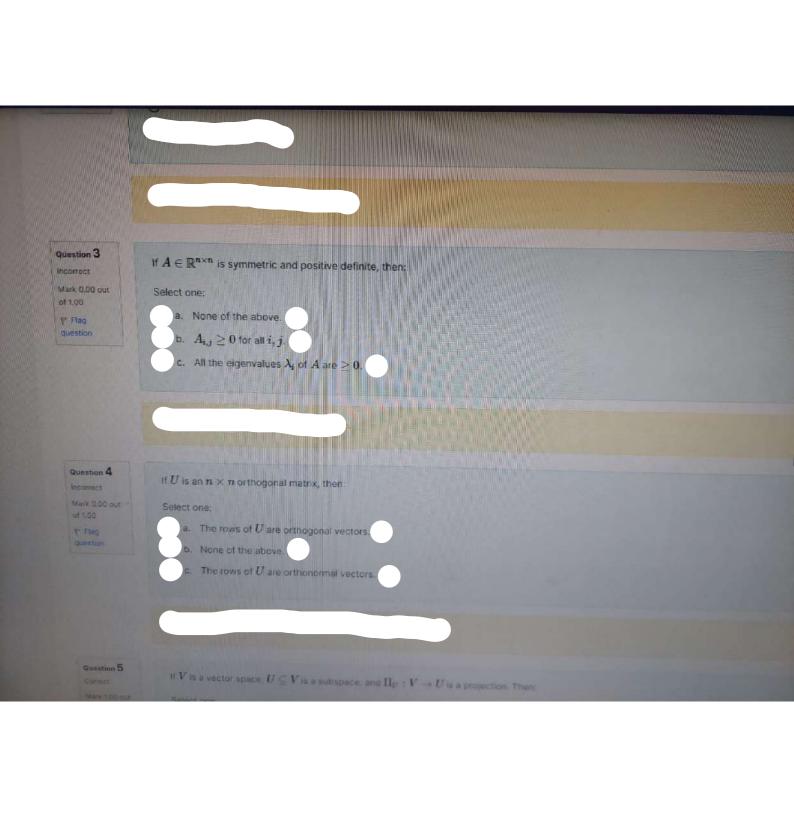
b. ||Ux||>||x||.

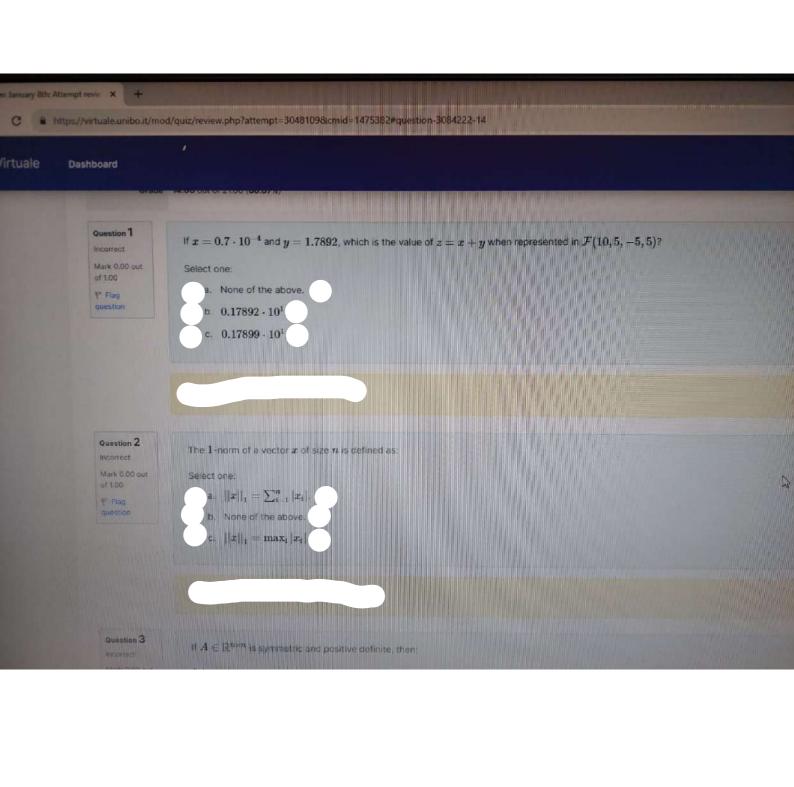
c. ||Ux|| < ||x||.











### Question 11

Correct

Mark 1.00 out of 1.00

P Flag

If  $f:\mathbb{R}^n o \mathbb{R}$  . Which of the following statements is False?

Select one:

a. 
$$x^*$$
 local minimum for  $f \Longrightarrow 
abla f(x^*) = 0$ .

b. 
$$abla f(x^*) = 0 \implies x^*$$
 stationary point for  $f$ .

c. 
$$abla f(x^*) = 0 \implies x^*$$
 local minimum for  $f$ .

## Question 12

Correct

Mark 1.00 ou

P Flag

Let 
$$f:\mathbb{R}^2 o\mathbb{R}$$
,  $f(x_1,x_2)=9x_1x_2^2-x_1$ ,  $\nabla f(x_1,x_2)=(9x_2^2-1,18x_1x_2)$  then which of the following is a stationary point for  $f$ 

Select one

a. (0,0).

b. None of the above.

c. (0,3).

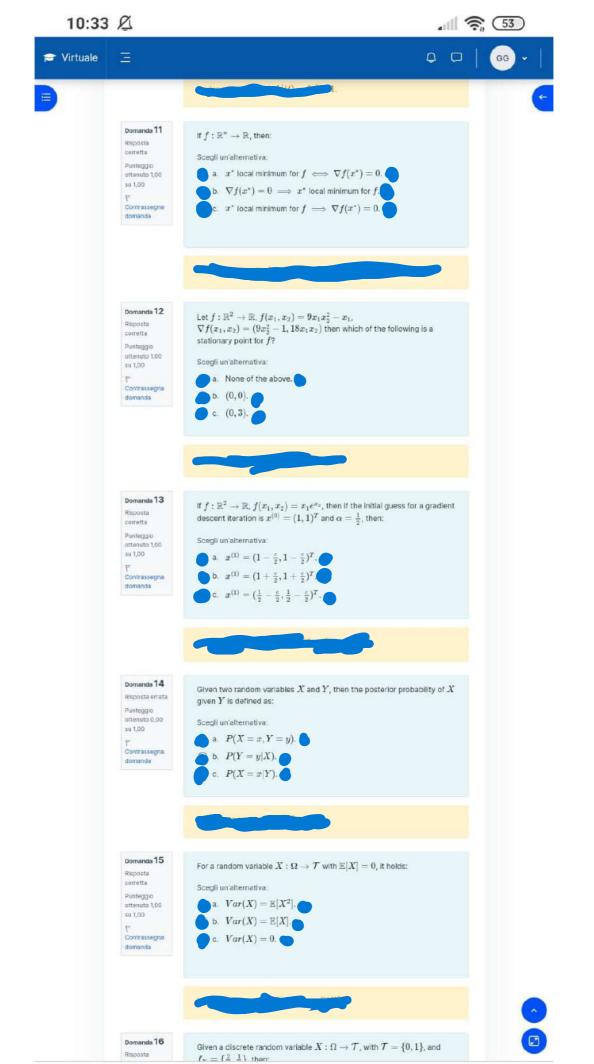
## Question 13

Murk 0 00 :

If  $f: \mathbb{R}^n \to \mathbb{R}$ ,  $f \in \mathcal{C}^1(\mathbb{R}^n)$ , then the Gradient Descent method  $x_k$ ,  $j=x_k-\alpha_k \nabla f(x_k)$  converges to a stationary point of f if.

Select one

On manage











GG



Puntaggio ottenuto 1,00 su 1,00 Scegli un'alternativa:

- a. E[X] = 1.
- b.  $\mathbb{E}[X] = \frac{2}{3}$ .
  - c.  $\mathbb{E}[X] = \frac{1}{3}$ .

## Domanda 17

P Contrassegna

domanda

corretta

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Punteggio ottenuto 1,00 511 1,00

Contrassegna domanda

If X,Y are multivariate random variables with states  $x,y\in\mathbb{R}^D$  , then:

- a.  $Cov(X,Y) = \mathbb{E}[X,Y^Y] \mathbb{E}[X]$ .
- b.  $Cov(X,Y)=\mathbb{E}[X,Y]+\mathbb{E}[X]\mathbb{E}[Y]$  .
- c. Cov(X, Y) = Cov(Y, X).

## Domenda 18

Punteggio attenuto 1,00 su-1.00

Contrassegna domanda

Given two random variables X and Y, Bayes Theorem implies that  $p(y|x) = rac{p(x|y)p(y)}{p(x)}$  where:

Scegli un'alternativa:

- a. p(x|y) is called likelihood on y.
- b. p(x|y) is called prior distribution on x.
- c. p(x|y) is called posterior distribution on y.

### Domanda 19

Risposta corretta

Punteggio ottenuto 1,00 su 1,00

Contrassegna domanda

Given two random variables X and Y such that  $p(x)=cc^{-|x|}$  and  $p(y|x) = rac{1}{\sqrt{2\pi}}e^{-rac{1}{2}(y-ax)^2}$  , then the MLE reads:

Scegli un'alternativa:

- a.  $x^* = \arg\min_x \frac{1}{2}(y ax)^2 + \frac{1}{2}x^2$ .
- b.  $x^* = \arg\min_x \frac{1}{2} (y ax)^2 + |x|$ .
- c.  $x^* = \arg\min_{x} \frac{1}{2} (y ax)^2$

## Domanda 20

Risposta non

Punteggio max = 1,00

domanda

Suppose a set of data  $(x_i,y_i), i=1,\ldots,N, y_i=f(x_i)+\epsilon_i$ , where  $\epsilon_i \sim \mathcal{N}(0, \sigma^2)$  . In linear regression, the likelihood function is:

Scegli un'alternativa:

- a.  $p(y|x, \theta) = \prod_{i=1}^{N} \mathcal{N}(x|x_i^T \theta, \sigma^2)$ .
- b. None of the above.
- c.  $p(y|x, \theta) = \prod_{i=1}^{N} \mathcal{N}(y|x_i^T \theta x_i, \sigma^2)$ .

## Domanda 21

Risposta errata Punteggio attenuta 0,00

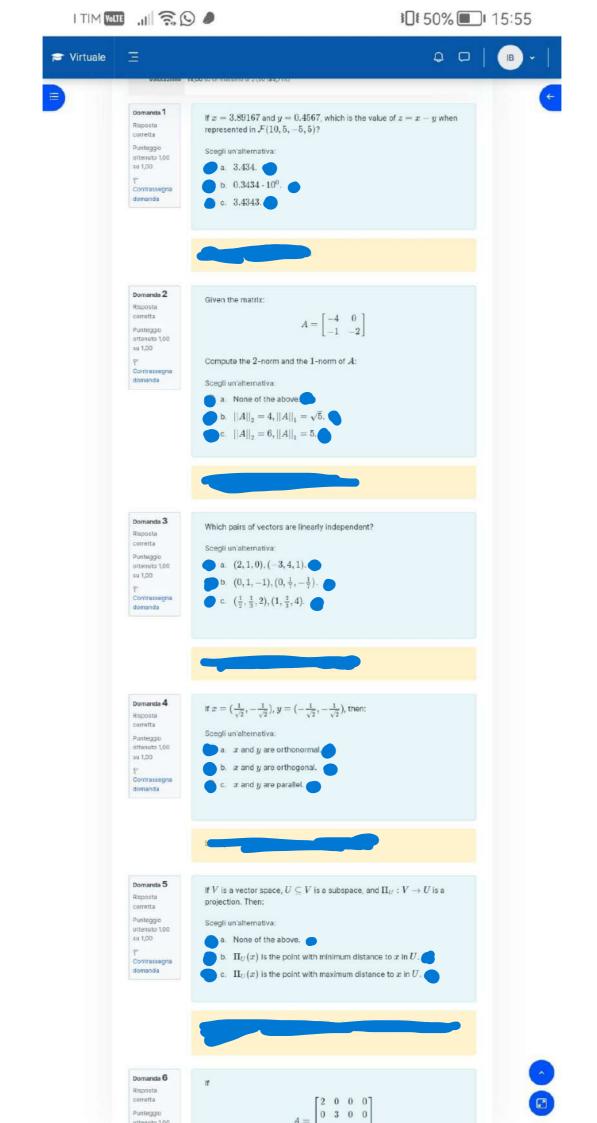
A solution of  $\min_x ||Ax-b||_2^2$  where A is an m imes n matrix,  $m \geq n_\epsilon$ rank(A) = k < n, can be computed as:

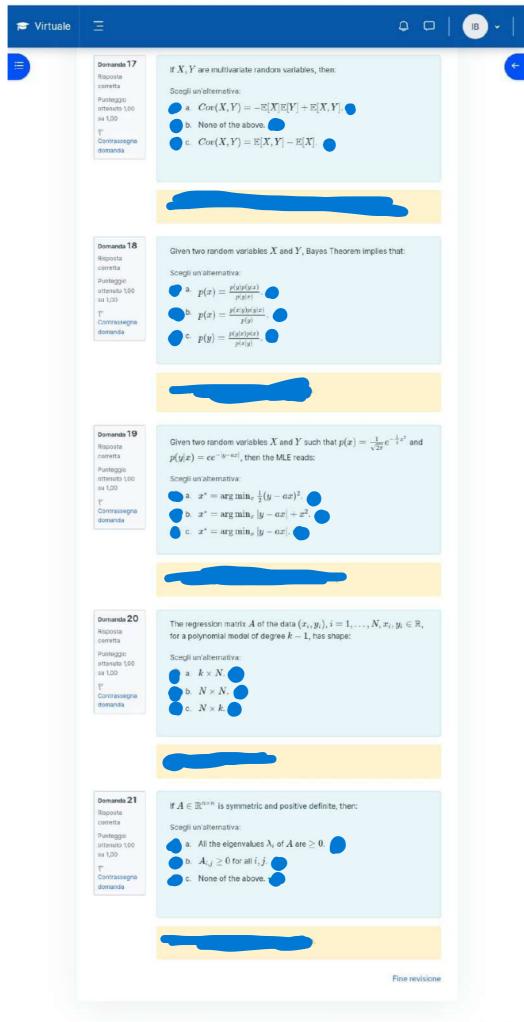
Scegli un'alternativa

 $\bigcirc$  a.  $x = A^+b$ .



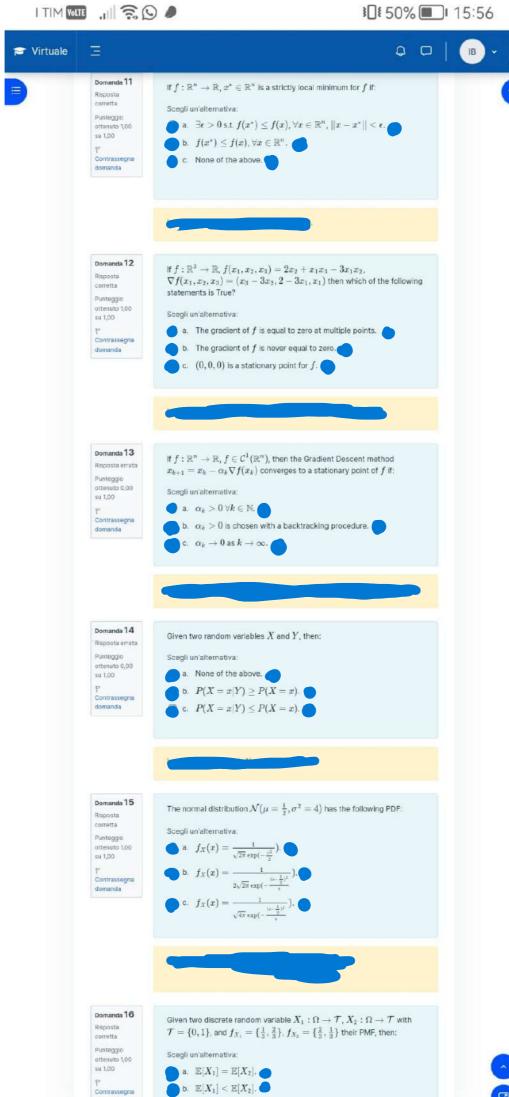






Sezione precedente

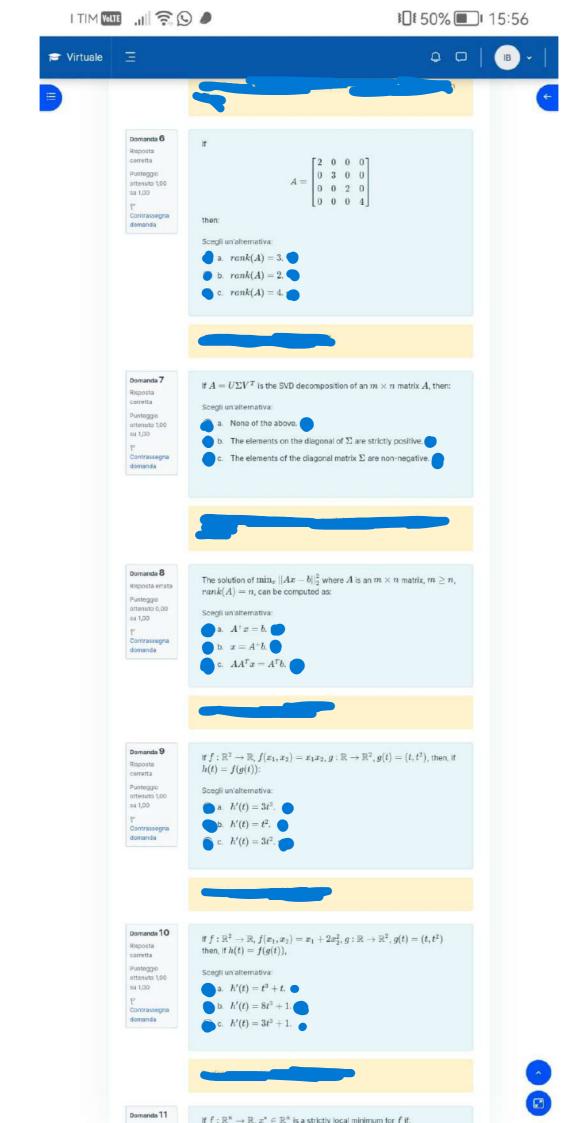
Vai a...



b.  $\mathbb{E}[X_1] < \mathbb{E}[X_2]$ .

c.  $\mathbb{E}[X_1] > \mathbb{E}[X_2]$ .

domanda



Risposta corretta

Punteggio
ottenuto 1,00 su

Contrassegna

If  $x=0.7\cdot 10^{-4}$  and y=1.7892, which is the value of z=x+y when represented in  $\mathcal{F}(10,5,-5,5)$ ?

Scegli un'alternativa:

- a. None of the above.
- a. Note of the above.
- b. 0.17899 · 10<sup>1</sup>.
- □ 0.17899.

#### Domanda 2

Risposta corretta Punteggio ottenuto 1.00 su

Contrassegna

If A is symmetric and positive definite and  $\lambda_1 \geq \lambda_2 \geq \cdots \geq \lambda_n$  are the eigenvalues of A, then:

Scegli un'alternativa:

- a.  $||A||_2=\sqrt{\lambda_1}$  .
- ||--||2 V-11
- b.  $||A||_2 \lambda_1$ .

  c.  $||A^{-1}||_2 = \lambda_n$ .

#### Domanda 3

Risposta corrett

Punteggio
ottomilo 1,00 su
1,00

Contrassegna domanda The matrix:

$$A = egin{bmatrix} 1 & 2 \ 3 & 6 \end{bmatrix}$$

is:

Scegli un'alternativa:

- a. Semi-negative definite:
- b. Positive definite.
- c. Semi-positive definite.

## Domanda 4

Risposta corretta Punteggio ottenuto 1,00 su

Contrassagna

If 
$$x=\left(\frac{1}{\sqrt{2}},-\frac{1}{\sqrt{2}}\right)$$
,  $y=\left(-\frac{1}{\sqrt{2}},\frac{1}{\sqrt{2}}\right)$ , then:

Scegli un'alternativa:

- a. None of the above.
- b.  $oldsymbol{x}$  and  $oldsymbol{y}$  are orthonormal.
- c. x and y are orthogonal.

## Domanda 5

Risposta corrett Punteggio ottenuto 1,00 su

₹ Contrassegna

If V is a vector space with  $dim(V)=n,U\subseteq V$  is a subspace with dim(U)=k, then:

- a.  $U \cup U^{\perp} = U$ .
- b.  $U\cap U^\perp=\{0\}$ .
- c.  $U \cap U^{\perp} = \emptyset$ .

Risposta corretta Puntaggio ottenuto 1,00 su

Contrassegna

If  $f:\mathbb{R}^n o \mathbb{R}$ . Which of the following statements is False?

Scegli un'alternativa:

- a.  $x^*$  local minimum for  $f \Longrightarrow 
  abla f(x^*) = 0$ .
- b.  $abla f(x^*) = 0 \implies x^*$  local minimum for f
- c.  $abla f(x^*) = 0 \implies x^*$  stationary point for f.

Domanda 15

Punteggio ottenuto 1,00 su

Contrassegna

If  $f: \mathbb{R}^2 \to \mathbb{R}$ ,  $f(x_1,x_2)=2\sin x_1+\sin x_1\cos x_2$ ,  $\nabla f(x_1,x_2)=(2\cos x_1+\cos x_1\cos x_2,-\sin x_1\sin x_2)$  then which of the following is a stationary point for f?

Scegli un'alternativa:

- a.  $(-\frac{\pi}{2},0)$ .
- b. None of the above.
- c. (0,0).



Domanda 13

Risposta corretta Punteggio ottenuto 1,00 su

Contrassegna

If  $f:\mathbb{R}^2 o\mathbb{R}$ ,  $f(x_1,x_2)=x_1^2+\cos(x_2)$ , then if the initial guess for a gradient descent iteration is  $x^{(0)}=(1,\frac{\pi}{2})^T$  and  $\alpha>0$ , then:

Scegli un'alternativa:

- a.  $x^{(1)}=(1+2lpha,rac{\pi}{2}+rac{\pi}{2}lpha)^T$ .
- $\mathbf{b}$ .  $x^{(1)}=(1-2lpha,rac{\pi}{2}+lpha)^T$ .
- $x^{(1)}=(1-2lpha,rac{\pi}{2}+rac{\pi}{2}lpha)^T$



Domanda 14

Plisposta corretta Punteggio ottenuto 1,00 su

P Contrassegn

Given two random variables X and Y, then:

Scegli un'alternativa:

- $P(X=x|Y) \leq P(X=x)$
- b.  $P(X=x|Y) \geq P(X=x)$ .
- c. None of the above.



Domanda 15

Risposta corretta Punteggio ottenuto 1,00 su

P Contrassegna

For a random variable  $X:\Omega o \mathcal T$  , it holds:

Scegli un'alternativa:

- $lacksquare a. Var(X) = \mathbb{E}[X^2] \mathbb{E}[X]^2.$
- b.  $Var(X) = \mathbb{E}[X]^2 \mathbb{E}[X^2]$ .
- c.  $Var(X) = \mathbb{E}[X^2] + \mathbb{E}[X]^2$ .



Risposta corretta Punteggio ottenuto 1,00 su Given two discrete random variable  $X_1:\Omega o\mathcal{T}$ ,  $X_2:\Omega o\mathcal{T}$  with  $\mathcal{T}=\{0,1\}$ , and  $f_{X_1}=\{\frac{1}{3},\frac{2}{3}\}$ ,  $f_{X_2}=\{\frac{2}{3},\frac{1}{3}\}$  their PMF, then:

Risposta corretta Punteggio ottenuto 1,00 su

Contrassegna

Given two discrete random variable  $X_1:\Omega\to\mathcal{T}$ ,  $X_2:\Omega\to\mathcal{T}$  with  $\mathcal{T}=\{0,1\}$ , and  $f_{X_1}=\{\frac{1}{3},\frac{2}{3}\}$ ,  $f_{X_2}=\{\frac{2}{3},\frac{1}{3}\}$  their PMF, then:

Scegli un'alternativa:

- a.  $\mathbb{E}[X_1] > \mathbb{E}[X_2]$ .
- b.  $\mathbb{E}[X_1] = \mathbb{E}[X_2]$ .
- c.  $\mathbb{E}[X_1] < \mathbb{E}[X_2]$

## Domanda 17

Pomanda 1/ Risposta corretta

P Contrassagna

If X,Y are multivariate random variables, then:

Scegll un'alternativa:

- a. None of the above.
- b.  $Cov(X,Y) = -\mathbb{E}[X]\mathbb{E}[Y] + \mathbb{E}[X,Y]$
- $\mathsf{Cov}(X,Y) = \mathbb{E}[X,Y] \mathbb{E}[X].$

## ...

## Domanda 18

Punteggio ottenuto 1,00 su 1,00

Contrassegna

Given two random variables X and Y, Bayes Theorem implies that

$$p(y|x)=rac{p(x|y)p(y)}{p(x)}$$
 where:

Scegli un'alternativa:

- a. p(x|y) is called posterior distribution on y.
- b. p(x|y) is called likelihood on y.
- c. p(x|y) is called prior distribution on x.



### Domanda 19

Risposta corretta Punteggio ottenuto 1,00 su

P Contrassegna

Given two random variables X and Y such that  $p(x)=rac{1}{\sqrt{2\pi}}e^{-rac{1}{2}x^2}$  and

 $p(y|x)=rac{1}{\sqrt{2\pi}}e^{-rac{1}{2}(y-ax)^2}$  , then the MLE reads:

Scegli un'alternativa:

- a.  $x^* = \arg\min_{x = \frac{1}{2}} (y ax)^2 + x^2$ .
- **b**.  $x^* = \arg\min_x \frac{1}{2} (y ax)^2 + \frac{1}{2} x^2$ .
- c.  $x^* = \arg\min_{x = \frac{1}{2}} (y ax)^2$ .

## Domanda 20

Risposta corretta

Punteggio ottenuto 1,00 su 1,00

Contrassegna domanda Suppose a set of data  $(x_i,y_i)$ ,  $i=1,\ldots,N$ ,  $y_i=f(x_i)+\epsilon_i$ , where  $\epsilon_i\sim\mathcal{N}(0,\sigma^2)$ . In linear regression, the likelihood function is:

Scegli un'alternativa:

- $\mathbf{p}(y|x, \theta) = \prod_{i=1}^{N} \mathcal{N}(y|\theta^{T}x_{i}^{N}, \sigma^{2}).$
- $p(y|x, heta) = \prod_{i=1}^N \mathcal{N}(y_i| heta^T x_i,\sigma^2)$  .
- $igcup_{i=1}^{c} p(y|x, heta) = \prod_{i=1}^{N} \mathcal{N}(x| heta^T x_i,\sigma^2)$  .

## Domanda 21

lisposta corretta

If 
$$f:\mathbb{R}^3 o\mathbb{R}$$
 ,  $f(x_1,x_2,x_3)=2x_2+x_1x_3-3x_1x_2$  ,

Risposta corretta

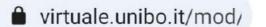
Punteggio

Contrassegna

If  $f:\mathbb{R}^3 o\mathbb{R}$  ,  $f(x_1,x_2,x_3)=2x_2+x_1x_3-3x_1x_2$  ,  $abla f(x_1,x_2,x_3) = (x_3-3x_2,2-3x_1,x_1)$  then which of the following is a stationary point for f?

- - a. (0,0,0).
- b. None of the above.
- c. (0,2,0).

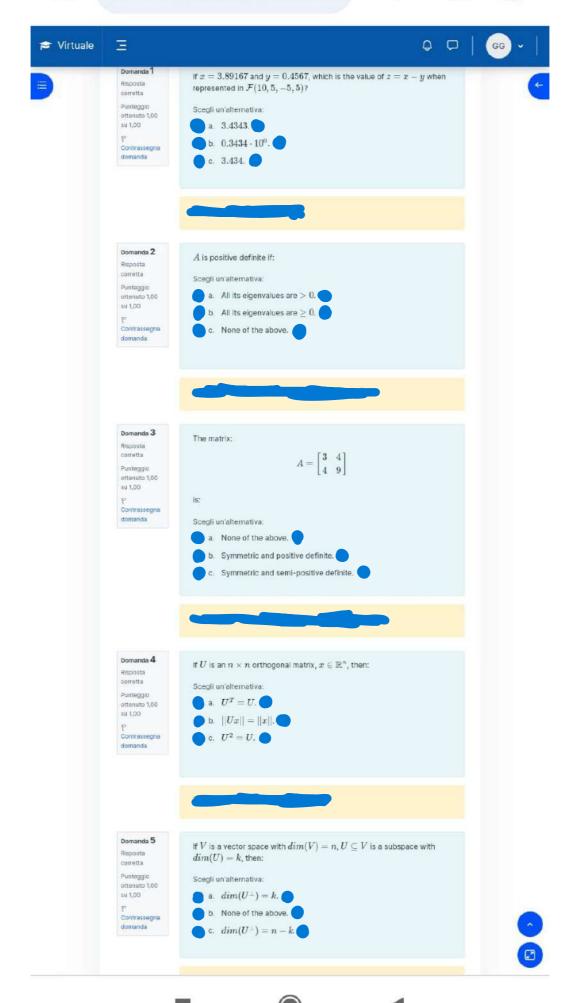












Risposta

corretta Punteggio ottenuto 1,00

su 1,00 F Contrassegria

domanda

If V is a vector space with dim(V)=n,  $U\subseteq V$  is a subspace with dim(U)=k, then: Scegli un'alternativa:

a.  $U \cap U^{\perp} = \emptyset$ . b.  $U \cap U^{\perp} = \{0\}$ . c.  $U \cup U^{\perp} = U$ .









Risposta coiretta Punteggio ottenuto 1,00 su 1,00

(\*) Contrassegna domands

$$A = \begin{bmatrix} 2 & 0 & 0 & 0 \\ 0 & 3 & 0 & 0 \\ 0 & 0 & 2 & 0 \\ 0 & 0 & 0 & 4 \end{bmatrix}$$

then:

Scegli un'alternativa:

- a. rank(A) = 4.
- b. rank(A) = 2.
- c. rank(A) = 3.

Domanda 7

Risposta corretta

Puntoggio ottenuto 1,00 su 1,00

Contrassegna domanda

If  $A=U\Sigma V^T$  is the SVD decomposition of an  $m\times n$  matrix A, then:

Scedi un'alternativa:

- a. The singular values  $\sigma_i$  of A are  $\sigma_i = \sqrt{\lambda_i(A^TA)}$  where  $\lambda_i(A^TA)$  are the eigenvalues of  $A^TA$ .
- b. None of the above
- c. The singular values  $\sigma_i$  of A are  $\sigma_i=\lambda_i(A^TA)$  where  $\lambda_i(A^TA)$  are the eigenvalues of  $A^TA$ .

Domanda 8 Risposta

corretta

Punteggio ottenuto 1,00 su 1,00

Contrassegna domanda

The problem  $\min_x ||Ax - b||_2^2$  where A is an  $m \times n$  matrix,  $m \ge n$ , rank(A) = k,

Scegli un'alternativa:

- a. Has a unique solution if and only if k < n.
- igcup b. Has a unique solution if and only if k=n.
- c. None of the above.

Domanda 9

corretta

Punteggio ottenuto 1,00 su 1,00

Contrassegna domanda

If  $f: \mathbb{R}^2 \to \mathbb{R}$ ,  $f(x,y) = \sqrt{x^2 - y^2}$ ,  $g: \mathbb{R} \to \mathbb{R}^2$ ,  $g(t) = (e^{2t}, e^{-t})$ then, if h(t)=f(g(t)),

Scegli un'alternativa:

- a.  $h'(t) = \frac{2e^{6t}-1}{e^t\sqrt{e^{6t}-1}}$ .
- $h'(t) = \frac{2e^{it} e^{-it}}{\sqrt{e^{it} + e^{-2it}}}$ .
- $h'(t) = rac{2e^{it} + e^{-2t}}{\sqrt{e^{4t} e^{-2t}}}.$

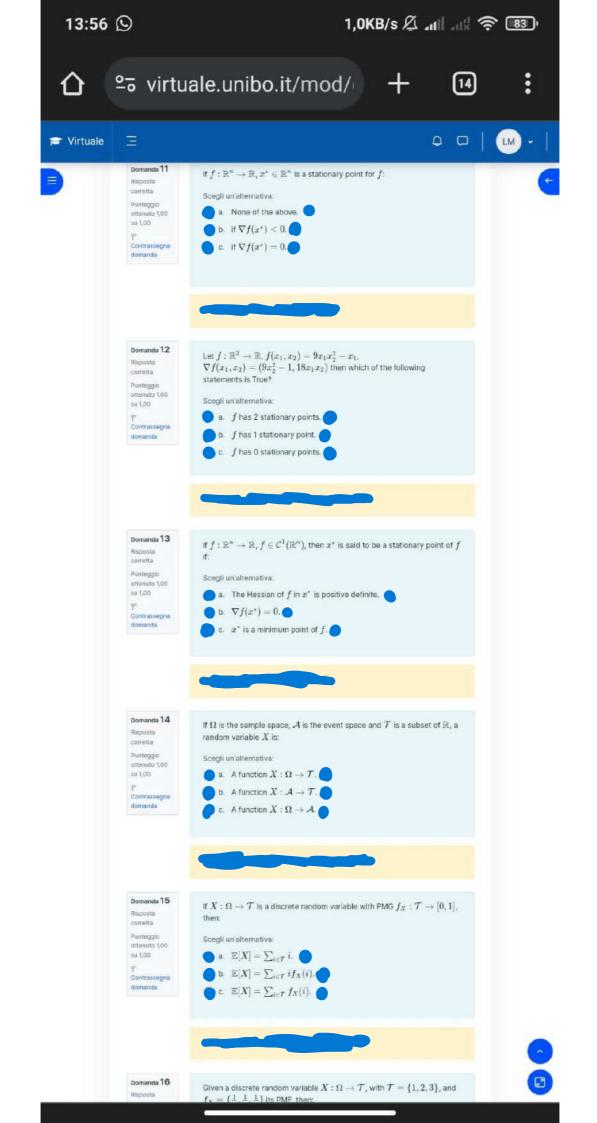
Domanda 10

Risposta corretta Punteggio ottonuto 1,00 au 1.00

Contrassegna domanda

If  $f:\mathbb{R}^2 \to \mathbb{R}$ ,  $f(x_1,x_2)=x_1+2x_2^2$ ,  $g:\mathbb{R} \to \mathbb{R}^2$ ,  $g(t)=(t,t^2)$ then, if h(t) = f(g(t)),

- **a**.  $h'(t) = t^3 + t$ .
- **b.**  $h'(t) = 3t^3 + 1$ .
- c.  $h'(t) = 8t^3 + 1$ .







Punteggio attenuto 1,00

Contrassegna domanda

ou 1,00

Given a discrete random variable  $X:\Omega o\mathcal T$ , with  $\mathcal T=\{1,2,3\}$ , and  $f_X=\{rac16,rac13,rac12\}$  its PMF, then:

Scegli un'alternativa:

- lacksquare a.  $\mathbb{E}[X]=6$ .
- lacksquare b.  $\mathbb{E}[X]=2$ .
- c.  $\mathbb{E}[X] = \frac{14}{6}$ .

# -

## Domanda 17

Risposta errata Punteggio ottenuto 0,00

P Contrassegna domanda If X is a random variable with values in  $\mathbb{R}^D$  ,  $V_x$  is the variance of  $X_i$  then:

Scegli un'alternativa:

- a.  $V_x[X]$  is a vector D imes 1.
- b.  $V_x[X]$  is a matrix D imes D.
- c.  $V_x[X]$  is a scalar.



### Domanda 18

Risposta

Punteggio ottenuto 1,00 su 1,00

Contrassegna domanda The quantity of interest in Bayes' Theorem is:

Scegli un'alternativa:

- a. The posterior.
- b. The marginal.
- c. The likelihood.

## Domanda 19

Risposta

Puntaggio ottenuto 1,00 su 1,00

P Contrassegna domanda Given two random variables X and Y such that  $p(x)=\frac{1}{\sqrt{2\pi}}e^{-\frac{1}{2}x^2}$  and  $p(y|x)=ce^{-|y-ax|}$ , then the MAP reads:

Scegli un'alternativa:

- a.  $x^* = \operatorname{arg\,min}_x |y ax| + \frac{1}{2}x^2$ .
- b  $x^* = \arg \min_x \frac{1}{2} (y ax)^2$
- c.  $x^* = \arg\min_x |y ax|$ .

## Domanda 20

Risposta errata

Punteggio ottenuto 0,00 su 1,00

Contrassegna domanda Suppose a set of data  $(x_i,y_i)$ ,  $i=1,\ldots,N,y_i=f(x_i)+\epsilon_i$ , where  $\epsilon_i\sim\mathcal{N}(0,\sigma^2)$ . In linear regression, the likelihood function is:

Scegli un'alternativa:

- a. None of the above.
- b.  $p(y|x,\theta) = \prod_{i=1}^{N} \mathcal{N}(x|x_i^T\theta, \sigma^2)$ .
- c.  $p(y|x,\theta) = \prod_{i=1}^{N} \mathcal{N}(y|x_i^T \theta x_i, \sigma^2)$

## Domanda 21

Rispostar

data Punteggio

Punteggio max: 1,00

Contrassegna domanda If  $f:\mathbb{R}^3\to\mathbb{R}$ ,  $f(x_1,x_2,x_3)=x_1^2-3x_2^2x_1-x_3x_2$ , then  $\nabla f(\frac{1}{2},\frac{1}{2},\frac{1}{2})$  equals to:

- **a.**  $(\frac{11}{4}, -1, \frac{1}{2})$ .
- b.  $(\frac{11}{4}, 1, \frac{1}{2})$ .
- c.  $(\frac{11}{4}, \frac{1}{2}, -1)$ .



Puntengio ottenuto 1,00 su 1,00

Contrassegna

If

$$A = \begin{bmatrix} 2 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 2 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

then:

Scegli un'alternativa:

- a. rank(A) = 2
- b. rank(A) = 4
- rank(A) = 3.

Domanda 7

Punteggia ottenuto 1,00 su 1,00

P Contrassegna

If  $A = U\Sigma V^T$  is the SVD decomposition of an m imes n matrix A, then:

Scegli un'alternativa:

- a. The columns of U are eigenvectors of  $AA^T$
- b. The rows of  $V^T$  are eigenvectors of  $AA^T$ .
- c. None of the above

### Domanda 8

Risposta corretta

Contrastegna

The problem  $\min_x ||Ax-b||_2^2$  where A is an m imes n matrix,  $m \geq n$ , rank(A) = k,

Scegli un'alternativa:

- a. Has infinite solutions.
- b. Has a unique solution if k=n.
- c. Has a unique solution for any k.

### Domanda 9

Risposta corretta Punteggio ottenuto 1,00 su

Contrassegna domanda If  $f:\mathbb{R}^3 o\mathbb{R}$ ,  $f(x_1,x_2,x_3)=\sin x_1-\sin x_2\cos x_3+x_3^2$ , then  $\nabla f(\frac{\pi}{2},\frac{\pi}{2},\pi)$  equals to:

Scegli un'alternativa:

- a.  $(1,0,2\pi)$ .
- b. (0,0,π).
- c. (0, 0, 2π).

## Domanda 10

Risposta corretta Punteggio ottenuto 1,00 su

Contrassegna domanda

If 
$$f:\mathbb{R}^2 o\mathbb{R}$$
 ,  $f(x_1,x_2)=x_1x_2$  ,  $g:\mathbb{R} o\mathbb{R}^2$  ,  $g(t)=(t,t^2)$  then, if  $h(t)=f(g(t))$  ,

- a.  $h'(t) = t^2 + 1$ .
- $h'(t) = 2t^2$
- $h'(t)=3t^2$ .